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COMPARATIVE STATISTICS OF RAILROAD RATES.

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In studying financial statistics of railroad operation it is a task of almost overwhelming magnitude to compare each item of a freight schedule or a passenger tariff with corresponding items in earlier or later schedules, and so diverse would be the results of such comparisons, if accomplished, that generalization in regard to the course of rates would be almost impossible. When comparisons are undertaken between different sections or countries, the task is even more complicated, and any generalization is rendered almost impossible by the lack of correspondence between the different items of the schedule. It has therefore become a matter of great interest to statisticians to find some method of averages by which freight or passenger rates can be compared in different periods or different places. It is commonly assumed that the problem has been solved in the "ton-mile" or "passenger-mile" statistics now in very general use.

These statistics are compiled in the following manner: Each shipment of freight is reduced to the basis of one mile; for example, a consignment of twelve tons carried ninety miles is expressed as equivalent to 1080 tons carried one mile; all the shipments, after being reduced to this basis, are added

together; thus all the freight transported on railroads in the United States in the year ending June 30, 1896, was equivalent to 95,328,360,278 tons transported one mile.* For transporting this freight the railroads received $786,615,837.† Dividing this sum by the number of tons we find that the revenue per ton-mile was .806 cent.‡

Similarly, if a passenger travels 983 miles it is counted as equivalent to 983 passengers travelling one mile. All the journeys of all the passengers are added, and we find that there were in the year 1895–96, 13,049,007,233 passengers carried one mile in the United States.§ The railroads received for this service $266,562,533.‖ Consequently, by a process of division, we get 2.019 cents as the revenue per passenger-mile.¶

Such calculations as this have about them a charm of simplicity, and if a change in the rates were the only cause which could occasion a variation in the average, this method would be as satisfactory as could be desired. That these averages really are conclusive is assumed quite widely by writers on railroad statistics. From among a multitude of possible illustrations it may suffice to quote two or three at random. The president of the Santa Fé system, in a memorial to the Kansas legislature, published in the *Railway Age* of Feb. 12, 1897, declares that his railroad has been steadily reducing freight rates in Kansas, and in proof of this he shows that the rate per ton-mile, Dec. 31, 1882, was 2.288 cents, and June 30, 1896, 1.028 cents, "making a decrease from 1882 to 1896 of 55.07 per cent." *The Eighth Annual Report of the Interstate Commerce Commission* sets forth on page 228 tables of ton-mile and passenger-mile statistics from various countries designed to show that rates in the

* *Ninth Annual Report on the Statistics of Railways*, p. 59.
† *Id.*, p. 343.
‡ *Id.*, *ib.* The correct quotient would seem to be .825.
§ *Id.*, p. 59.
‖ *Id.*, p. 342.
¶ *Id.*, *ib.* Apparently it should be 2.043 cents.

United States are the "lowest in the world." The Senate Finance Report on *Wholesale Prices, Wages, and Transportation* gives a table showing the number of cents per ton-mile received for freight transportation by certain railroads in 1860 and in 1892, and this comment follows: "For the dates named this table gives a very interesting and instructive comparison. It shows a very great reduction in freight rates." The same report declares on page 614 that "no presentation of the tendency toward lower charges for freight transportation by railways is at once so comprehensive, accurate, and readily understood as a statement of the average charges per ton per mile prevailing during successive periods."

President Ripley doubtless knows whether freight rates in Kansas have been reduced in late years, though his figures fail to throw any light on the subject. It is not the purpose here to enter on the controverted question whether American rates are higher or lower than in some other countries, nor to deny that freight rates in the United States may have fallen somewhat during a period whose most marked economic characteristic has been the universal fall in general prices. But an effort will be made to show that no presentation of railroad charges is at once so misleading, inaccurate, and certain to be misunderstood as a statement of the average charges per ton per mile prevailing during successive periods. The demonstration is not difficult. It consists only of showing that the "average" rate is a resultant of several causes, and that a change in any one of these causes is quite capable of modifying the average most profoundly; in consequence it is utterly illogical to select arbitrarily a single one of these causes and attribute all fluctuations in the average solely to variations in rates.

To begin with freight rates: If all the freight transported between any two points were taken at a uniform rate regardless of the character of the commodity the case would be marvellously simplified. But as a matter of fact there are

almost as many different rates as there are kinds of goods. To make it easier to grasp the case, however, we will suppose all freight to be grouped into five classes, and in the case of two railroads of equal length the rates on each road between its termini are precisely the same, *viz.*: —

First Class	. . . . .	60 cents per cwt.
Second "	. . . . .	45 " " "
Third "	. . . . .	35 " " "
Fourth "	. . . . .	30 " " "
Fifth "	. . . . .	20 " " "

Is it not evident that, although the rates are precisely the same on the two roads, the revenue per ton-mile may be very different on the two, and that it cannot possibly be the same unless the proportion of each class of freight carried by both roads is precisely the same? Suppose, for example, that one of the termini of one road is at the center of the production of some staple commodity included in Class 5, while the other road handles little 5th class freight, except what is going to consumers along its line, is it not plain that, other things being equal, the revenue per ton-mile will be much less in the case of the first road than in the case of the second? Or, if we confine our attention to a single road at different periods it is perfectly obvious that any industrial change which increases the relative proportion of low class freight handled lowers the revenue per ton-mile, and any increase in the proportion of high grade freight raises the revenue per ton-mile, rates remaining precisely the same.*

* *The Senate Finance Report* (vol. 1, p. 43,) shows the per cent of tonnage in each class forwarded by the trunk lines from New York to and beyond the western termini in : —

	1889.	1892.
Class 1	22.2	19.9
" 2	6.9	5.4
" 3	12.8	11.3
" 4	13.0	10.4
" 5	7.8	9.6
" 6	37.3	43.4
	100.0	100.0

Here is a variation of nearly eighteen per cent in three years in the relative proportion of 5th and 6th class to higher grade freights,—a variation which is utterly ignored by the *Report* when rates are being considered.

But the cent-per-ton-mile theory assumes that a change of rate is the only cause which can make a variation in the revenue per ton-mile, and that therefore a rise or fall of the revenue per ton-mile is conclusive proof of a corresponding rise or fall of rates.

But this is only half of the story. We have confined our attention to traffic between the termini alone. Now let the way stations be inserted. It costs just as much to load and unload freight for a journey of five miles as for a journey of five hundred miles. Consequently, if a railroad company charged for freight going five miles only the bare cost of loading and unloading, and then charged one hundred times as much for transporting freight 500 miles, the latter rate would be prohibitive of almost all traffic over the longer distance. No railroad manager would think of making such a charge. In general, the longer the distance a consignment of freight is to travel the less per mile is the charge.

Now disregarding, for the sake of simplicity, the complexities of "classification," let us suppose two roads of equal length, with way stations similarly located along each, and the freight rates between any two stations on the one precisely the same as between the corresponding stations on the other. But let us assume that in one case the greater share of the business passes over the whole length of the road from one terminus to the other, but in the case of the second a greater share of the business is between the way stations. Other things being equal, it must be obvious that the revenue per ton-mile of the first road will be less than that of the second, although rates are precisely alike on both. Or, in the case of a single road over a period of time, an increase in the "way" traffic relative to the "through" business will increase the revenue per ton-mile, rates remaining just the same. But the theory under consideration necessarily implies that a change of rates is the only thing that can cause a change in the revenue per ton-mile, and that an increase or

decrease in the revenue per ton-mile is of itself conclusive proof of a corresponding increase or decrease of rates.

With slight modifications the same explanation applies to passenger business. While most of the travel in America is "first class," there are some "second class" and "emigrant" rates, and many circumstances under which a lower fare is charged on account of stricter limitations as to time. Consequently, the schedule of charges remaining precisely the same, the revenue per passenger-mile will be less the greater the proportion of passengers who travel second class or on the occasion of excursions or with mileage books.

Furthermore, as to distance, though for a different reason than in the case of freight, the fare for a very long ride is usually somewhat less per mile than for a short ride, with one exception. In the immediate environs of large cities the elasticity of demand for short distance travel is very great. Consequently, railroads favorably situated find it profitable to make such fares lower proportionately even than the charge for very long distances. We may divide passenger traffic roughly then into local, long distance, and suburban. The rates in each class remaining absolutely unchanged, the revenue per passenger-mile will be greater the shorter the average journey, except that an increase in the proportion of suburban travel lowers the revenue per passenger-mile.* But the statistical theory in question assumes it as self-evident that a change of rates must be the only cause that can possibly change the revenue per passenger-mile, and that therefore an increase or decrease of the revenue per

* The statistical report of the Interstate Commerce Commission gives these figures for the average journey travelled per passenger for a series of years. The tendency to increase is noticeable, though for reasons which cannot be detailed here the figures are absolutely much too small: —

Year.	Miles.	Year.	Miles.
1890	24.06	1894	26.43
1891	24.18	1895	24.02
1892	23.82	1896	25.50
1893	23.97		

passenger-mile is unassailable proof of a corresponding increase or decrease of passenger fares.

Finally another specific instance will show graphically the utter impossibility of discovering anything about the difference in rates between different roads or different years on the basis of any passenger-mile statistics. The city of Madison, Wisconsin, is connected with Chicago by three different railroads on each of which the fare between the two points is exactly the same and has been unchanged for a considerable number of years. But when we examine the data upon which the statistics of passenger revenue are based we find the utmost complexity. As the conductor goes through the train he finds at least six different sorts of tickets presented by passengers occupying the same car from Chicago to Madison. First there is the occasional passenger whose ticket has cost him $3.92. There is the clergyman with his "permit" who has paid $1.96 for the ride. There is the man who goes back and forth four or five times a year and has paid $25 for a thousand-mile ticket; the trip costs him $3.45. There is the man always "on the road" whose two thousand-mile book has cost him $40 net, the proportion of which applied to this trip amounts to $2 76. If it is summer there are the Chicago people going to the country for an outing with round-trip tickets each half of which cost $3.13, or if they are to return the next Monday, only $2.63. Each of these different forms has been available regularly for several years at exactly the prices named and on each of several different roads. But it must be perfectly manifest that the revenue per passenger-mile may be most radically changed by any circumstances which affect the relative proportions of these different sorts of travel to one another.

So much for one factor in the revenue per passenger-mile, the money paid. Now for the other factor, the miles travelled. The distance from Chicago to Madison by one road is 176 miles, by another from 131 to 164 miles, according to the

train taken,* and by the other from 166 to 181 miles, according to the route.† Now as the fare is just the same whichever route is taken,‡ and as there are nine different routes, each of a different length, by which regular passenger trains are run every week-day in the year, it must again be evident that the revenue per passenger-mile will depend on the proportion of the travel which goes by the different routes. It will be less on the Illinois Central than on the Northwestern, since that route is the longer. It will vary on the Northwestern and the St. Paul roads from year to year according as any slight changes of time-tables or other causes serve to make some trains more generally convenient than other trains for this particular travel.

To sum up, differences in the average receipts per passenger per mile or per ton per mile may be due to differences in the rates, or to either one of two other sets of independent causes, or to any possible combination of these. It is therefore impossible to determine, from comparisons of ton-mile or passenger-mile averages, anything whatever in regard to the differences in freight or passenger charges.

Remarks by Henry C. Adams.

The remarks by Dr. Swain upon the passenger-mile and ton-mile unit in railway statistics present in a very forceful manner a truth which none deplore more than those who are obliged to work constantly with this class of statistics. The difficulty to which he refers does not, however, so much lie in the imperfect character of the unit as in the fact that, up to the present, railway reports fail to separate

* Distance from Chicago to Madison on the Chicago & Northwestern Railway via the routes taken by trains—

"Nos. 3 and 5"	131 miles.
"No. 1"	138 "
"No. 7"	145 "
"No. 9"	153 "
Trains running via Milwaukee	164 "

† Distance from Chicago to Madison on the Chicago, Milwaukee & St. Paul Railway

Via Watertown	168 miles.
Via Whitewater	181 "
Via Rockford	166 "

‡ This is true even if one uses mileage books, as the conductors take up the same amount of mileage for the trip, whatever train one happens to travel on.

their traffic and earnings on the basis of the kinds of freight and classes of passengers carried. This has for some time been within the purpose of the Federal and the State Railroad Commissioners. Indeed, a plan for the classification of freight revenue was at one time accepted, but the late depression of railway earnings led to the postponement of its execution. It is quite possible, now that prosperity has returned, that another effort will be made to analyze receipts per ton per mile, and receipts per passenger per mile, in such a manner as to make them much more significant than they now are.

It may be doubtful if any statistician would consent to the abandonment of the ton-mileage and passenger-mileage unit, nor do I understand that such is the purpose of Dr. Swain's criticisms. This unit has received the approval of the *Institut International de Statistique*, and is adopted in the reports of all important countries with the exception of England. Progress certainly lies in the development of the unit rather than in its abandonment. The matter of international comparisons is a most difficult one. Within the past ten years there have been at least two attempts to establish uniformity in the railway statistics of Europe, but nothing very definite has been accomplished. For some reason the project fails to interest those who administer the French railways, and without France it has not been thought expedient to press the proposal. Should it be again undertaken, and the idea is by no means abandoned, the Interstate Commerce Commission has received assurances that the United States will be invited to take part in the conference. Meantime, and in the absence of any better unit of comparison, it seems wise to retain the ton-mileage unit, and to undertake its development so as to obviate the criticisms that may justly be made upon it.

It may be proper to say a word respecting the apparent discrepency, to which Dr. Swain calls attention, between the receipts per ton per mile and per passenger per mile as reported by the Interstate Commerce Commission and as arrived at by dividing the aggregate of reported receipts by the aggregate of reported traffic.

The rule adopted by the Commission for computing averages is to exclude from the aggregates made use of all figures returned in reports that are not in all respects complete and satisfactory so far as the item under consideration is concerned. To illustrate, from the case in hand, some roads may return freight receipts but not ton-

nage; some may return freight receipts and tonnage but not ton-mileage; some may return tonnage and ton-mileage but not receipts. The averages which appear in the Statistics of Railways are computed from balanced and satisfactory returns. It is thought by this means to arrive at a statement more nearly correct than by the other method of computation. It should be added, however, that there is no considerable number of unbalanced returns.

Remarks by Arthur T. Hadley.

All careful students of railroad economy will sympathize with Prof. Swain in his protest against the abuse of ton and passenger-mile statistics. But many of them will consider that, in his zeal against their abuse, he has gone so far as to deny their legitimate use; and will stop far short of his conclusion that it is "impossible to determine from comparisons of ton-mile or passenger charges *anything whatever* in regard to differences in freight or passenger charges."

What Prof. Swain has proved thoroughly is that variations and differences on the average receipt per passenger-mile or per ton-mile are not necessarily accompanied by corresponding variations and differences in the tariff schedules of the roads concerned. What his opponents may perhaps fairly claim is (1) that, taking charges on the same road in different years, the correspondence between average rates and tariff schedules is in practise very much closer than Prof. Swain's paper would lead us to suppose; (2) that in comparisons between different roads it is possible to make abstraction of the more important disturbing elements in such a way as to guard against the abuses which Prof. Swain so justly condemns; (3) that for many purposes the average actual receipt is a more important basis of comparison than the tariff schedule.

I shall confine my discussion to the last point, which is least obvious and most important.

It is assumed in Prof. Swain's paper that if two railroads have the same tariff schedule they are charging the same rates. From one standpoint this is obviously true; from another standpoint it is, to say the least, an extremely doubtful proposition.

If one road is getting nearly all high-class freight and another is getting a great deal of low-class freight the first is actually receiving

higher average rates than the second. If one road gets all the ministers, and another gets all the commercial travellers, and a third gets all the excursionists, it is fair to say that they have different average rates for their services. The character of the business done by a railroad is not a matter of accident. It is largely dependent upon traffic management. The company that has developed low-class traffic is entitled to credit for its efforts. Of course low-class traffic is far easier to develop in some districts than in others. A man who builds a road into a region which is unfavorably constituted in this respect has his choice between two courses. He can content himself with doing high-grade business and avow that he charges high rates because his services are valuable; or he can make the extraordinary efforts needed to develop the low-grade business in his locality. In the absence of the latter alternative he must accept the former.

A road is to be judged by the business that it does, rather than by the business that it doesn't do. The ton-mileage statistic, rough as it is, has at least the merit of dealing with traffic actually handled. The tariff-schedule comparison, plausible as it seems, has the demerit of giving disproportionate weight to traffic which is *not* actually handled. The ton-mileage comparison has many sins to answer for; but this particular sin of not conforming to the tariff-schedule comparison seems often to be a virtue rather than a vice.

Remarks by Emory R. Johnson.

Statistical data used for comparison should be carefully analyzed in order to make sure that the data compared are accurate and comparable. In his paper on "Comparative Statistics of Railroad Rates" Dr. Swain has done well to call attention to the factors that affect the ton-mile and passenger-mile earnings of railroads,— the unit of most significance in the comparisons made in railway transportation statistics.

The statement made by Dr. Swain that ton-mile and passenger-mile averages are influenced by several factors is true, but is neither new nor startling. I do not know that the persons whose scientific attainments give them a right to be heard have ever claimed that "change of rates is the only thing that can cause a change in the revenue per ton-mile." Dr. Swain has indeed enumerated only a

few of the many causes influencing the ton-mile revenue of the railroads. The revenue per ton-mile depends not only upon the character of goods and upon distance travelled, but also upon the amount of goods carried, the season at which they are moved, the character of the road, whether it be a level one or one containing curves, the proportion which the traffic one way bears to that moving the other, the relation of dead weight to load, and upon many other factors well known to the practical railroad man and the student of transportation.

The criticism which Dr. Swain offers as to making comparisons of ton-mile and passenger-mile earnings of different periods, to indicate the fall which railroad charges have undergone, has some force when the comparisons made are those between the earnings for different periods of a single railway company or railroad system. It is quite possible that the character of the business done by a particular road, or the conditions under which the business is performed, may so change as to make the ton-mile and passenger-mile averages of one period the resultant of factors appreciably different from those which determine the averages of another period. It would, however, be somewhat difficult to show that any very radical change has taken place during the past ten or fifteen years in the character of the business done by such a system as the Atchison.

When, however, Dr. Swain says that "no presentation of railroad charges is at once so misleading, inaccurate, and certain to be misunderstood as a statement of the average charges per ton per mile prevailing during successive periods"; and when he declares that it is "impossible to determine, from comparisons of ton-mile or passenger-mile averages, anything whatever in regard to the differences in freight or passenger charges" he makes a statement that is not only exaggerated but inaccurate. The ton-mile and passenger-mile earnings of the railways of the United States as a whole are excellent general averages. It would be difficult to find many better general averages in statistics. There are over a thousand operating railway companies, and the kinds of goods carried number several thousands. The average earnings per ton per mile of this large number of companies engaged in the movement of this great variety of commodities presents a general average whose excellence appeals to every statistician. The Senate Finance Report on *Wholesale Prices, Wages, and Transportation* makes an essentially accurate statement when it declares

that "no presentation of the tendency towards lower charges for freight transportation by railroads is at once so comprehensive, accurate, and readily understood as a statement of the average charges per ton per mile prevailing during successive periods."

Dr. Swain's paper contains a wholesome protest against the kind of reasoning often indulged in by interested parties that have a thesis to prove regarding railway charges; but as a criticism on the utility of the ton-mile and passenger-mile earnings of the railways, as units for the measurement of the course of railway charges, much of the paper is, to say the least, misleading.

Remarks by H. T. Newcomb.

Dr. Swain's contribution to the study of railway rates is an excellent example, though graciously devoid of the spirit of malice too often noticed, of a form of criticism to which statistical work is frequently subjected, which consists principally in assuming that an unattainable object has been sought and condemning the failure to succeed in accomplishing a task that was not and should not have been attempted. Statisticians, practicing a modesty which they share with all who wish to deal with facts in a scientific manner, do not commonly assume that many problems have been "solved" by their method, and those among them who have delved in the facts which pertain to railway transportation do not assert, as Dr. Swain too boldly intimates in his opening paragraph, that absolutely accurate or entirely satisfactory comparisons among railway rates are practicable. Those who are accustomed to seek accuracy of expression, whether by means of figures or the careful choice of words, will perceive some difference between the conclusion that: "It is therefore impossible to determine, from comparisons of ton-mile or passenger-mile averages, anything whatever in regard to the differences in freight or passenger charges," and the "not difficult" demonstration which consists in showing that such averages are somewhat affected by variations in factors other than rates that results from the preceding effort "to show that no presentation of railway charges is at once so misleading, inaccurate, and certain to be misunderstood as a statement of the average charges per ton per mile prevailing during successive periods."

The real question is not whether there are such variations, but whether they are sufficient materially to affect the averages. It may

be perfectly true, as stated by Mr. McCain in the report of the Committee on Finance of the Senate on *Wages and Prices*, that: "No presentation of the tendency toward lower charges for freight transportation by railways is at once so comprehensive, accurate, and readily understood as a statement of the average charges per ton-mile prevailing during successive periods," even though there is a possible margin of error in such a statement due to several causes including those noticed by Dr. Swain. No fact in statistics is more commonly recognized than that the death rate of a particular community is in some degree affected by the age distribution of those composing it, yet statisticians do not believe that comparisons among crude death rates fail to throw some light upon the relative healthfulness of different communities. The variations in the factors which independently of changes in rates may effect variations in the averages per ton-mile probably affect the latter even less than death rates are affected by variations in age distribution. They might modify the average "most profoundly," but in practice they do not, and the propriety of attributing to variations in rates, the fluctuations in ton-mile averages, so far as to claim that the latter throw valuable light on the former, is far less a question of logic than one of fact.

The comparative unimportance of the variations in ton-mile averages which result from fluctuations in the relative quantities of freight in the different classes may be shown by applying actual rates and distances to the figures showing the percentage of tonnage in each class during 1889 and 1892 quoted from the report of the Committee on Finance in a foot-note to Dr. Swain's paper as follows: —

Class.	Per cent of tonnage.		Rates. New York to Buffalo. per 100 pounds.	Per cent of tonnage multiplied by rate.	
	1889.	1892.		1889.	1892.
1	22.2	19.9	39	865.8	776.1
2	6.9	5.4	33	227.7	178.2
3	12.8	11.3	28	358.4	316.4
4	13.0	10.4	19	247.0	197.6
5	7.8	9.6	16	124.8	153.6
6	37.3	43.4	13	484.9	564.2
	100.0	100.0		2,308.6	2,186.1

According to the foregoing the average rate per ton of freight from New York to the Trunk Line termini was $4.62 in 1889 and $4.37 in 1892, and the average rate per ton per mile on the basis of the distance between New York and Buffalo was 1.049 cents in the former and 0.994 cent in the latter year. Though the difference of one-half of a mill would scarcely vitiate the comparison even if the result of causes entirely independent of fluctuations in rates, it is not, as Dr. Swain has rather hastily assumed, the consequence of changes in the character of shipments, for the increased percentages in the lower classes in 1892 were caused by modifications in the classification of freight which, between 1889 and 1892, had transferred many articles to the lower classes. This was fully explained in the report together with the fact that changes in classification result in actual changes in rates.

The other sources of error indicated are not more important. In accordance with the same law which determines that in an extensive community there will be during equal periods approximately the same number of murders and suicides, the passengers of the country purchase during different years about the same relative proportions of the different classes of tickets, and shippers forward different commodities in quantities varying, with regard to each other, even less. It is to be observed that the article does not cite a single fact which tends to establish the relative probability of changes in the averages being due to the several causes which affect them.

All those who have studied the subject are aware of the conditions which limit the rate per ton-mile and passenger-mile averages and wish to see the classification of railway statistics extended until it will be possible to give such averages separately for different classes of traffic. It is desirable, for example, to have the average rate per passenger mile for passengers travelling on each of the great classes of tickets. Both passengers and freight should also be classified as local or through traffic, according to their general direction and according to the distance traversed. Before these data can be secured, however, there must be a considerable development of railway accounting, and in the mean time statisticians will be obliged, as they are in connection with many other problems, to be satisfied with the best results that can be obtained under limiting conditions which they recognize and regret.

It should be remarked that the criticism of the report of the Statistician to the Interstate Commerce Commission, implied by the foot-notes calling attention to the differences between the average rates per passenger and per ton per mile reported, and the actual quotients obtained by dividing passenger revenue by passenger-miles and freight revenue by ton-miles, is not well founded. The reports on Railway Statistics very properly give the aggregate of revenue and of passenger and freight mileage for all railways which report any of those items, but before obtaining the averages it is always necessary to deduct the revenue of roads which do not report their passenger or freight mileage.

Remarks by C. E. Prevey.

In this article two problems appear to be involved: First, the mathematical question which lies on the surface, whether or no a decline in the average receipts per ton or passenger-mile necessarily implies a reduction of rates; and, second, an ethical question regarding the fairness of rates, which is implied in the treatment of the subject. Considering first the mathematical question, we cannot agree with the writer of the article in giving a negative answer. We should answer the question as just stated in the affirmative, and for the following reason: By a reduction in rates we can mean nothing else than average rates. We cannot mean individual rates for the shipment of a given class of goods over a given piece of road, because these are too numerous and too fluctuating to be compared, and the only thing that can be compared is the *average* amount received for the shipment of a ton of freight one mile, which is found by dividing the total freight receipts by the number of tons carried one mile. This average amount may be lowered by the reduction of tariff rates or by an increase in the relative amount of low-class freight shipped, the schedules remaining the same. The latter is as truly a reduction in average freight rates as the former.

The writer gives a number of examples showing how the average rate may be lowered while the schedule of rates or tariff remains the same. Perhaps the following table will help to make clear the relation of these factors: —

FREIGHT TRAFFIC.

	1.	2.	3.	4.
Causing low rates...	Long Distances	Large Shipments	Low Value of Goods	Competition
Causing high rates..	Short Distances	Small Shipments	High Value of Goods	Lack of Competition

PASSENGER TRAFFIC.

	1.	2.	3.	4.
Causing low rates...	Low Class Service	Long Distances	Suburban Traffic, Special Rates, etc.	Competition
Causing high rates..	High Class Service	Short Distances	....	Lack of Competition

Under the column of freight traffic are shown four of the principal qualifications which tend to give a low-freight rate to any particular shipment of goods, and their opposites which tend to give a high rate. The value of the goods by weight is the chief factor determining the "classification," and second in importance is the size of the particular shipment.

The less the value and the larger the amount shipped, other things being equal, the lower will be the class. Thus coal will be in a lower class than coffee, and either will be classed lower in car-load lots than in smaller quantities. Then the longer the distance and the more competition the less will be the rate per ton-mile for any given "class" over any given piece of road. A similar explanation applies to the column under passenger traffic.

The article shows in an interesting manner, by a number of concrete examples, how a change in the character of the traffic in the direction indicated in the upper row in the diagram may lower the average rates, *viz.*, in passenger traffic a larger percentage of low-class service (2nd and 3rd class, limited tickets, etc.), more long-distance travel, more suburban traffic or more traffic between competitive points; and in freight traffic a larger percentage of cheap goods, more car-load shipments, more long-distance consignments, and more traffic between competitive points.

This does not affect the mathematical question which we have stated, but it does have a practical bearing on the more important ethical question, which is this: Has the reduction in average rates per ton-mile been at the expense of the railroad companies and a

direct gain to the public, or does it consist merely in doing less work for less money? Does the average ton-mile represent a smaller service now than it did when rates were higher? The answer to this question requires an analysis of the items tending toward lower rates as illustrated in the upper part of the diagram.

Let us assume that the tariffs have remained exactly the same, and that the reduced average receipts per ton-mile are due to a change in the nature of the traffic,— then the answer to our second question depends on which of the four factors (under freight traffic) has been instrumental in reducing the revenue. If it be due to either (1) or (2),— larger shipments or longer distances,— it means that the cost of service is less, and the reduced rate is no loss to the railroad and no gain to the public. But if the reduced revenue is due to the transportation of more low-priced goods or more traffic between competitive points it is *not* accompanied by a diminished cost to the railroads, and is a gain to the customers. The higher rates previously charged, when the freight was valuable and competition absent, were high, not on account of a large expense of handling, but because, under the principle of charging what the traffic will bear, those goods were found to be able to bear a high charge. Now under the changed character of traffic no such relatively large quantity of freight is found which will bear such charges, and so the average has been lowered. Likewise in the case of passenger traffic, if the reduction is due to a larger proportion of low-class service or of long journeys it means a less expensive service, and is no gain to the public; but if it is due to more travel between places having low rates on account of competition or more suburban traffic it means a cutting down of the monopoly profits of the railroads, and is a gain to the public.

Now the examples given in Mr. Swain's paper show that the reduction in average rates has been due to the operation of both causes,— those which reduce the cost, and those which reduce the monopolistic power of the railroads. Just how much it is due to each, and how far it is a direct benefit to the customers, it would be difficult to determine. One fact which lies on the surface is that the low average freight rates per ton-mile in this country are due chiefly to the enormous amount of long distance freight traffic.

COMPARATIVE STATISTICS OF RAILROAD SERVICE UNDER DIFFERENT KINDS OF CONTROL.

By C. E. Prevey.

From the standpoint of the consumer of railroad services the intrinsic merits of any railroad system are measured by the quantity and quality of the service rendered and by the price. Both quantity and quality of service and price are influenced by the character of the government control over the railroads. It is the purpose of this paper to present some of the leading facts regarding quantity and quality of service rendered by railroads under different systems of railroad control.

Among the items under the head of railroad service are the following: Frequency, speed and regularity of trains, safety, furniture, and equipment of cars; rules as to carrying baggage, conveniences of making connections, station equipment, and courtesy of officials. Only the first two of these can be studied statistically. This paper will be confined chiefly to the first item, — frequency of trains.

In comparing the efficiency of different systems of railroad control in different countries, it must be remembered that there are many other circumstances which affect the character of the service and prices besides the method of control. No decision as to the merits of government or private ownership can be drawn off-hand from a comparison of services and rates in different countries. The density of population, topography, geographical location, natural distribution of products, and, most of all, the state of civilization of the people have more to do with the development of railroading than the particular system of control adopted.

There are a number of methods of comparing railroad development which do not distinguish between quantity and quality of service: First by a comparison of the ratio of

railroad mileage to area or to population. These two kinds of comparisons give widely different results and are faulty, because the former makes too favorable a showing for the small and densely populated countries, while the latter favors the large and sparsely populated countries.

Another method of comparing railroad services is the "density of traffic" measure. By this is meant the average number of passengers and tons of goods transported over each mile of railroad. The first difficulty with this comparison is that it takes no account of the extent of the railroad system. A country like India may have only a few miles of road connecting the most populous centers which will show a great density of traffic and yet the country at large be very poorly supplied with railroad facilities. In addition to the above objections to these methods of comparison there is the further objection that none of them make any account of quality of service. The patrons of the road may be accommodated by any number, more or less, of trains per annum and yet it will make no difference in the figures.

Another proposed means of comparison is by frequency of trains, which is found by dividing the whole number of miles run by trains in a year by the miles of road. This has the advantage of exhibiting the quality of service,— the more frequent the trains the greater the accommodations to the patrons of the road. It is lacking, however, in that it shows nothing about the *extent* of railroad service, or how far it meets the wants of the people as a whole.

As opposed to all these methods of comparison there is still another which does take into account to some extent the quality and quantity of service relative to the whole population. This is the train mileage per capita basis of comparison. In the denominator of the fraction, $\frac{\text{train-mileage}}{\text{population}}$ the interests of the whole people are represented. In the numerator quality and quantity are both represented in a rough way, since the mileage depends on length of road and frequency

of trains. At the same time some allowance is made for density of population because the average distances will be greater in the thinly populated countries.

In Table I is shown the train mileage per 1000 inhabitants for each of the leading countries of the world for the latest dates obtainable. The countries are arranged in three groups according to the kind of control. The railroads in the first group of countries are all owned and operated by private companies with the exception of a small part of the roads in Canada.

TABLE I.— ANNUAL TRAIN MILEAGE PER 1,000 INHABITANTS.

	State.	Year.	Train Mileage per 1,000 Population.	Miles Under Control of State.	Private.
I.	United States....	1895–96	11,981	....	180,891
	Great Britain....	1895	8,815	....	21,174
	Canada.....	1895	8,134	1,346	14,631
II.	France.....	1894	4,776	1,608	22,833
	Italy.....	1890	1,237	5,260	2,895
	Switzerland.....	1894	4,860	....	2,220
	Hungary.....	1895	3,211	6,725	1,493
	Sweden.....	1895	1,262	1,851	3,603
	Holland.....	1894	4,040	1,936	.....
	India.....	1894	227		
	"	State owns and operates..			5,198
		State railroads worked by companies.....			8,605
		Private roads.....			4,697
					(*Statesman's Year Book.*)
III.	Germany	1895–96	4,328	25,205	3,032
	Belgium..	1895	5,348	2,061	794
	Russia.....	1894	876	11,131	9,472
	Norway.....	1895–96	1,554	960	42
	Australia	1895–96	7,660	9,754	.....

Statistics of population from the *Statesman's Year Book;* also statistics of railroad mileage in a few cases. Statistics of train mileage in this and the two following tables are from the *Archiv für Eisenbahnwesen.* Following are the citations to year and page: Great Britain, '97, 1126; Germany, '97, 1126; France, '96, 1126; Italy, '94, 894; Switzerland, '97, 84; Sweden, '97, 502; Holland, '96, 417; Belgium, '97, 1168; Russia, '97, 779; Norway, '97, 500; Hungary, '97, 945; India, '96, 779; Australia, '97, 1184; Canada, '97, 525; United States, *Poor's Manual*, '97; Austria, '97, 73.

The countries in the second group have a mixed system of government and private control. In France the government owns 1608 miles and the companies 22,833 miles, but the private roads are under a minute supervision by the government. In Italy part of the roads are owned by the state and part by private companies, but those owned by the state are leased and worked by the companies. In Switzerland the roads are owned and worked by private companies, but under the strict supervision of the government. In Sweden two-thirds of the mileage is under private control and one-third is owned by the state. In Holland the roads are chiefly owned by the state and rented out to private companies. In India both systems of railroad control exist.

In the third group of countries nearly all the railways are owned and operated by the state. In Russia about one-third* of the railroads are in the hands of companies, but the government owns a large part of the stocks.

A glance at this table shows that those countries whose roads are owned and operated by private enterprise have by far the largest train-mileage per capita. In the United States a train is run on the average 11.9 miles annually for each inhabitant. In England the number is 8.8 and in Canada 8.1 miles, while no continental European country has a train-mileage as high as five miles per capita, except Belgium, which has 5.34.

Table II shows the passenger and freight train-mileage per thousand inhabitants for the same years as given above.

The train mileage per capita is the best measure of comparative *railroad development* in different countries. That railroad development is dependent on many things besides the system of control is evident. The question arises whether there is any set of statistics of railroad services which eliminate the results of natural conditions and indicate more nearly the direct affects of the system of control.

* The companies owned in 1894, 9472 miles, and the state 11,131 ; but at the beginning of 1896 the state owned 16,126 and the companies 8464 miles.

TABLE II.— ANNUAL TRAIN MILEAGE PER 1,000 INHABITANTS.

(Same dates as in Table I.)

	Passenger.*	Freight.
United States	4,755	7,003
Great Britain	4,733	3,843
France	2,354	1,623
Germany	2,285	1,589
Switzerland (including mixed)	3,731	1,757
Belgium	3,054	2,145

It is suggested that some approximation toward this can be made by a double comparison, *viz.*, of the density of traffic and of the frequency of trains. The reasons and the method of such a comparison are as follows: —

The efficiency of any system is measured by the quality and price of the service and the supply of services rendered relatively to the potential demand. The potential demand is measured not by the amount of the population, but by the amount of use that would be made of railroad facilities if they were offered. Now, as we have seen, the first railroads in any country connecting the principal traffic points meet a very strong demand for railroad services, and the density of traffic is very great. As the railroad is extended the demand for services "on the margin" grows less and less, and the average density of traffic diminishes. Therefore the average density of traffic is an approximate measure of how nearly the extension of railroad facilities has approached to the existing demand for railroad services. The more the railroad system is extended, other things remaining equal, the lower will be the density of traffic. The demand for

* No account is here made of the mileage of mixed trains because complete statistics are not to be had. The proportion of mixed trains is larger in Continental Europe than in England or the United States, as shown by the following figures taken for the same dates and from the same source as the above: —

	Passenger Train Mileage.	Mixed Train Mileage.
United States	337,641,115	15,785,433
England	184,064,400	4,284,490
Germany	119,666,700	20,865,600
France	90,417,600	29,249,100

railroad services is very largely the result of natural conditions, state of civilization, etc. The supply of railroad services is very largely the result of the system of railroad control. It should be remembered, however, that the demand (as expressed in density of traffic) is very largely affected by railroad rates. Therefore, in comparing the density of traffic in different countries to determine how far the railroad system has met the demand, it is necessary to take into account the rates. Thus, in comparing the United States with India as to passenger traffic, we can not say that American railroads have necessarily come more nearly to the demands for travelling facilities on the grounds that the density of passenger traffic is greater in India. Our fares are very much higher than the fares in India, and we do not know what the density of passenger traffic would be in this country if fares were put down to the Indian tariff, nor what the density of passenger traffic in India would be if their fares were raised to the level of ours.

We can summarize the foregoing by saying that the efficiency of a railroad system in respect to quantity of service (relative to demand) is measured by the reciprocal of the average density of traffic. The quality of service is measured by the frequency of trains. These two quantities taken together are the measure of comparative service. The equation,

$$\text{Frequency of trains} + \frac{1}{\text{density of traffic}} = \text{price},$$

expresses the fact that, other things being equal, price should vary with frequency of trains and inversely with density of traffic.

Tables III and IV exhibit the density of traffic and frequency of trains of the important states. No statistics of density of traffic are kept in England, and we have not the figures for Canada, so that the only private owned roads with which we can compare are those of the United States.

TABLE III.— FREQUENCY OF TRAINS.

Average number of train-miles per mile of road.

	Total.	Passenger.*	Freight.
United States, 1896	4,702	1,867	2,750
Great Britain, 1895	16,005	8,700	7,103
Germany, 1896	8,097	4,244	2,913
France, 1893	7,608	3,756	2,580
Austria, 1895	5,219	(State roads only.)	
Hungary, 1895	5,693	....	....
Switzerland, 1894	6,451	(4,941 including mixed.)	1,510
Norway, 1896	2,905	....	....
Sweden, 1895	3,062	....	....
Russia, 1894	5,271	....	....
India, 1894	3,490	1,370	2,035
Australia, 1895-96	....	....	....
New South Wales	3,050	1,465	1,580
Victoria	2,881	....	....
Queensland	1,993	....	....
S. Australia	2,004	791	....

TABLE IV.— DENSITY OF TRAFFIC.

Number of ton-miles or passenger-miles per mile of line. (One ton = 2,000 pounds.)

	Passenger.	Freight.
United States	72,150	519,280
Great Britain	(No statistics.)	(No statistics.)
France	261,182	350,000
Germany	315,399	616,474
Switzerland	239,403	195,503
Sweden	76,462	150,932
Russia	189,600	706,689
Norway	91,552	68,959
Belgium	498,000	(State roads only.)
Austria	217,746	414,002
Hungary	143,000	348,700
India	315,085	232,000
New South Wales	41,200	....

Comparing the United States with India as to density of traffic we find that in passenger service in the United States there are 72,150 passengers carried over each mile of road annually, while in India the number is 315,000. Ignor-

* See footnote, p. 137.

ing the effect of the difference in rates this would indicate that in India roads have not been extended to places contributing small traffic to anything like the extent that they have in the United States. On the other hand, trains are run more frequently in the United States than in India. The number of passenger trains running over each mile of road was 1867 in the United States, and 1370 in India. Thus we conclude that, as far as passenger traffic is concerned, both the quantity and quality of service in India is far inferior that of the United States. Rates ought to be cheaper there than here, because trains run less frequently and the amount of traffic is greater, so that while in the United States the average number of passengers in a train is 35 in India it is 224 (see Table V). Comparing the United States and France, we find that for a given section of road France

TABLE V.—AVERAGE TRAIN LOADS.

	Passenger-Miles Per Passenger Train Mile.*	Ton-Miles Per Freight Train Mile.
United States	35	180
Germany	72	190
France	69	130
Switzerland	48	(Mixed train mileage included.)
Belgium	66	....
India	224	142
New South Wales	26	....

* See footnote, p. 137.

has over three times as many passengers to carry, and that passenger trains run about twice as often.* This shows better service in France on the lines operated. If we estimate the *extent* of service in proportion to demand by density of traffic we find that the density of passenger traffic is about three times as great in France as in the United States, while freight traffic is only three-fifths as great as in

* No account is made of mixed trains. In France the mileage of mixed trains is one-third of that of passenger trains, while in the United States it is about one-twenty-second.

the United States. This disparity between the density of freight traffic and passenger traffic makes it difficult to give the United States any definite rank from the stand-point of intensity of traffic. The passenger traffic of the United States is less dense than that of any European country, while the freight traffic is more dense than that of any country except Germany and Russia.

While this method of comparing quality of service will not enable us to establish definitely the relative quality of railway service in different countries it helps to correct some wrong impressions which result from a comparison of train-mileage per capita. Thus it is said that railroad fares are higher in this country than in Europe, partly because trains run oftener here than in Europe and carry smaller loads, whereas the statistics show that our passenger trains run less frequently than those of Europe. In the United States the annual number of passenger-train miles per mile of road is 1867; in England, 8700; in France, 3756; Switzerland, 4941; Germany, 4244; Belgium, 7215. It can not be maintained, therefore, that our train service is better than the European, unless it be on the grounds that European railroad systems are not so extensive as ours, — that they do not supply railroad facilities to so large a part of the population in remote districts where traffic would be small.

How far this is true is partly indicated, we think, by the table of density of traffic. All the European countries, except Germany and Russia, have a lighter freight traffic than the United States, which would indicate that their railroad systems were more extended in proportion to demand than ours. On the other hand, all the countries of Europe have a heavier passenger traffic than the United States. That the latter fact is due in large part to the lower fares in Europe is shown by the fact that in Hungary, when the zone tariff system was established a few years ago with a reduction in fares of from 40 per cent to 50 per cent, the number of passengers carried trebled the first year.* Even before the reduction in rates their fares were much lower than ours. It seems probable

* *Review of Reviews*, vol. v, p. 562.

that if fares in Europe were as high as in America the density of traffic would not be much greater.

In order to compare the train service of European railroads with that of roads under private ownership having equal density of traffic we have constructed Table VI. In this the states of the Union are divided into eight groups, and the table shows for each group of states the density of population, the density of passenger traffic, the per capita train-mileage, the number of miles run by passenger and freight trains per mile of road (frequency of trains), and the average train loads.

TABLE VI.—RAILROAD TRAFFIC IN THE UNITED STATES.

Group.	Passenger and Freight-Train Mileage per 1,000 Population.	Passenger-Train Mileage per Mile of Road.	Freight-Train Mileage per Mile of Road.	Passenger and Freight-Train Mileage per Mile of Road.	Passenger-Mileage per Mile (in 1,000).	Ton-Mileage per Mile.	Passenger-Train Load.	Freight-Train Load.
1	10,410	4,113	3,150	7,263	253 —	476 —	61	151
2.....	15,044	4,100	6,690	10,790	170 —	1,410 —	41	210
3.....	16,100	1,880	2,880	4,760	64.4	545	34	188
4.....	7,180	1,220	1,700	2,920	39	330	32	193
5.....	4,497	1,480	2,240	3,720	49.6	391	33	175
6.....	8,911	1,150	1,770	2,920	34	263	29	138
7	9,320	920	1,550	2,470	29.5	323	32	207
8.....	9,740	1,130	1,430	2,560	62.1	269	55	187
Mass	17,520	11,387	8,000	19,387	769.0	1,036	63	129

States in Each Group.	Density of Population.
1. Maine, N. H., Vt., Mass., R. I., Conn., ...	80
2. N. Y., N. J., Penn., Del., Md., ...	137
3. Ohio, Mich., Ind., Ill., Wis., ...	65
4. Va., W. Va., N. C., S. C., Ga., Fla., ...	78
5. Ala., Miss., Tenn., Kentucky, La., ...	44
6. Mo., Ark., Texas, Kansas, Col., N. Mexico, Okla., ...	14
7. Iowa, Minn., Neb., N. Dakota, S. Dakota, Wyoming, Montana, ...	9
8. Wash., Oregon, Cal., Nevada, Arizona, Idaho, Utah, ...	4
Massachusetts, ...	315

Railroad statistics from *Poor's Manual*, 1897. Population from *World Almanac*, 1897, p. 515.

We get, now, some very interesting results by comparing the different countries of Europe with that portion of the United States which most nearly resembles it in density of population and density of railroad traffic. Thus we will compare New England with Germany, France, Austria, and Switzerland: —

	Area.	Density of Population.	Density of Passenger Traffic.	Density of Freight Traffic.	Passenger-Train Mileage Per Mile.	Average Passenger Load.
New England	33,040	80	253	476	4113	61
Germany	211,103	201	315	616	4244	72
France	204,177	182	261	350	3756	69
Austria (state roads)	....	..	217	414	(5219 total)	..
Switzerland	15,981	181	239	195	(4941 including mixed)	48

(The figures under the heading "Density of Passenger Traffic" represent the number of thousands of passenger miles per mile of road. The figures in the next column show the number of thousands of ton-miles per mile of road.)

In Germany the density of passenger traffic is only one-fourth greater than in New England, and the freight traffic is 29 per cent greater. The frequency of passenger trains is a little greater in Germany than in New England. In France the density of passenger traffic is greater than in New England, the freight traffic is 64 per cent as great, and the frequency of passenger trains 92 per cent as great. So far we have not taken into account the mixed trains, because the mileage of mixed trains is not given for the separate states of the Union, nor for all the European countries. We find, however, that for the United States the mixed-train mileage is only about one-twenty-second of the passenger-train mileage, while in France it is one-third, and in Germany one-sixth of the passenger-train mileage. After making proper allowance for mixed trains we would find that the frequency of trains carrying passengers is greater in Germany and France than in New England.

In Austria the number of passenger-train miles is not given separately, but we may estimate them to be about three-fourths as many as in New England, and considering that the traffic is considerably lighter we see that even Austria is much better supplied with railroad facilities than is commonly supposed. Switzerland we find with a considerably lighter traffic, has a considerably larger number of passenger and mixed trains, and a much smaller average load.

Again, let us compare Hungary with the north middle states: —

	Density of Population.	Density of Passenger Traffic.	Density of Freight Traffic.	Passenger-Train Mileage Per Mile.
States	137	170	1410	4100
Hungary	137	143	348	(3000, estimated)

(The total train mileage per mile in Hungary is 5693, and we estimate the passenger mileage at about 3000 miles.)

In round numbers, Hungary, with a passenger traffic seven-eighths as dense, and a freight traffic one-fourth as dense, has about three-fourths as many passenger trains per mile per annum as has the great trunk line region of this country.

For a comparison of regions with lighter traffic we take Norway and Sweden and compare them with the United States west of the Rocky Mountains (Washington, Oregon, California, Nevada, Arizona, Idaho, and Utah): —

	Density of Population.	Density of Passenger Traffic.	Density of Freight Traffic.	Passenger-Train Mileage Per Mile.
States	4	62	269	1130
Norway	14	91	68	(total, 2890)
Sweden	27	76	150	(total, 3062)

Norway and Sweden have a heavier passenger traffic than the western states, but their passenger trains run oftener also. The total number of train miles per mile of road per annum is 2890 in Norway and 3062 in Sweden, and the number of passenger-train miles probably more than half of these figures, as compared with 1130 in the western states.

New South Wales has a density of passenger traffic of 41,200, — a little less than that of the southern states: Alabama, Louisiana, Mississippi, Tennessee, Kentucky, and passenger trains run with about the same frequency, the passenger-train mileage per mile being 1465 in New South Wales, and 1480 in the southern states.

If these comparisons are worth anything they show that European railroads, being chiefly under government ownership and charging much lower passenger rates, have supplied the demands for railroad facilities about as well as have the railroads of the United States. In frequency of trains they are seldom behind and usually ahead of American railways. High fares in the United States cannot be justified on the score of frequency of trains or size of train loads.

REVIEWS AND MISCELLANY.

DIVORCES GRANTED IN MICHIGAN DURING THE YEAR 1897.

A law passed by the legislature of 1897 requires county clerks to make a return to the Secretary of State of all divorces. This law took effect on August 29, 1897, but the returns, which were made for the first time in January, 1898, were for the entire calendar year, 1897. Each divorce is returned individually much in the same manner as a record of marriage, the following items being stated: Full name of each party; age of each in years; date of marriage; place of marriage; number of children in family; complainant; date of filing application; date of final action; alleged cause for divorce; whether contested; whether granted, refused, withdrawn, otherwise disposed of, or pending at end of year; conditions, if any. Besides the individual return on the schedule, the county clerk makes a summary, stating the total number pending at the beginning of the year; number of suits begun; divorces granted, refused, etc. It was found that these summaries were carelessly made in some cases, so that for the first year a compilation was based entirely upon the individual records of divorces granted, to which all of the figures given below refer.

It may be stated that not all divorces granted by the courts are properly entered on the records as such. The reason is that a small fee is required by the clerks of the courts for the final entry, and this is not always properly paid, either by the parties themselves or by their attorneys. As a result individuals may suppose themselves divorced and remarry, while the court records contain no record of the decree. This imperfection is probably not very great, and affects the data obtained by the United States Commissioner of Labor for Michigan some years ago. It is chiefly important to remember that the numbers given in the following tables are rather under the true figures.

The total number of divorces reported for the year 1897 was 1656. Of this number 423 were granted on the application of the husband,

and 1233 on application of the wife. Classified by place of marriage: 1360 of the marriages dissolved were performed in Michigan, 65 in the adjacent states of Ohio, Indiana, and Wisconsin, 101 in other states of the Union, 86 in Canada, 22 in other foreign countries, and 22 in unstated locality.

The total number of children affected by the divorce of their parents during the year was 1833, or a little more than one child to each divorce on the average. The distribution of children to divorced couples was as follows: —

		Number of Children in Family.													
	Total.	0	1	2	3	4	5	6	7	8	9	10	11	12	Unk.
Divorces granted	1656	771	407	199	127	52	35	16	13	2	2	2	1	1	28

The average duration of marriage until the granting of a divorce was 10.7 years. The distribution by five-year periods was as follows: —

		Duration of Marriage in Years.										
	Total.	Under 5 Years.	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	Unk.
Divorces granted.....	1656	472	464	301	177	115	61	25	21	5	1	14

The principal causes alleged in the applications for divorces are cruelty, desertion, non-support, drunkenness, adultery, and imprisonment. Frequently two or three of these causes are stated in combination, so that in the following table a statement is given of the total number of suits into which each cause entered as a factor, the total number granted for each cause as the sole reason, and some of the principal combinations under each head: —

Alleged Causes.	Number of Divorces Granted.		
	Total.	Husband.	Wife.
All causes	1,656	423	1,233
Cruelty	**849**	**177**	**672**
Cruelty	560	155	405
Cruelty and non-support	184	....	184
Cruelty and desertion	40	17	23
Cruelty and drunkenness	25	1	24
Cruelty and other causes	40	4	36
Desertion	**532**	**223**	**309**
Desertion	405	203	202
Desertion and non-support	67	....	67
Desertion and cruelty	40	17	23
Desertion and other causes	20	3	17
Non-support	**512**	....	**512**
Non-support	211	....	211
Non-support and cruelty	184	....	184
Non-support and desertion	67	....	67
Non-support and other causes	50	....	50
Drunkenness	**104**	**5**	**99**
Drunkenness	39	4	35
Drunkenness and cruelty	25	1	24
Drunkenness and other causes	40	.. .	40
Adultery	**62**	**43**	**19**
Adultery	49	36	13
Adultery and other causes	13	7	6
Imprisonment	**11**	....	**11**
Imprisonment	5	....	5
Imprisonment and other causes	6	....	6
Other and unknown	3	...	3

It will be seen that over one-half (51.3 per cent) of all divorces granted contain the allegation of "cruelty" as a factor, while about one-third of all the cases are granted on this allegation alone. About one-third of the total number of divorces involve desertion; these constitute a larger proportion (52.7 per cent) of the suits of husbands than of wives (25.1 per cent). Next to cruelty, non-support is the most frequent cause of divorces granted to wives (41.5 per cent). No divorces are granted to husbands for this cause. Drunkenness enters as a factor into 6.3 per cent of all cases. while adultery is alleged in 3.7 per cent. In the latter case, for obvious reasons, the statistics may be below the truth.

The above data are presented as a preliminary study of the results of the first year's registration of divorces in Michigan. A more complete analysis will be presented in the *Michigan Registration Report* now in press. There is certainly room for hope, when the system shall have become thoroughly established and the reporting officers have attained greater familiarity with the duties required, that some very valuable results will be obtained.

CRESSY L. WILBUR.

Division of Vital Statistics,
Department of State,
Lansing, Michigan, July 25, 1898.

CLASSIFICATION OF CAUSES OF DEATH.

The following circular letter has been sent by a committee of the American Public Health Association to registration offices of foreign countries, and to all state and municipal registration offices, boards of health, medical, pathological, statistical, actuarial, and other societies, and individuals making use of mortality statistics in the United States: —

The American Public Health Association at its meeting at Ottawa on September 28 to 30, 1898, recommended the adoption of the Bertillon classification of causes of death, a system reported to the International Statistical Institute at the session held at Chicago, 1893. The Conference of State and Provincial Boards of Health of North America also recommended the adoption of this system at the meeting held at Detroit, August 10 to 11, 1898.

Provision is necessary in adopting a system of classification of causes of death for regular periodical revisions in order to maintain it abreast of the advances of medical science. A plan for such revision has received the approval of the American Public Health Association, embracing the countries of Canada, Mexico, and the United States, and has also been accepted by the statistical service of France. This plan provides for the completion of the revision, with the coöperation of all countries using this system, by the year 1900, and its promulgation in connection with the session of the International Congress of Hygiene and Demography to be held at Paris

in that year. This will enable the mortality statistics of the next century to be begun on a uniform basis.

It is desired that as many countries as possible signify their intention to make use of this international system, and take an active part in the work of revision. The conduct of the work in each country will be vested in a representative commission of three members, one of whom will act as the National Secretary.

In connection with this work of revision the Committee of the American Public Health Association on Demography and Statistics in their Sanitary Relations is preparing a pamphlet showing the present form of the Bertillion system. This list is to be used as a basis of reference in suggesting changes from the present form.

The members of the commission for the three countries represented in the American Public Health Association have been appointed by the President of the Association with the approval of the Executive Committee as follows: —

Dr. Emmanuel P. Lachapelle, Montreal, P. Q.	CANADA.
Dr. Peter H. Bryce, Toronto, Ont.	
Dr. Elzéar Pelletier, *Secretary*, Montreal, P. Q.	
Dr. Eduardo Licéaga, Mexico, Mexico.	MEXICO.
Dr. Jesus E. Monjarás, San Luis Potosi, Mexico.	
Dr. Jose Ramirez, *Secretary*, Mexico, Mexico.	
Dr. Samuel W. Abbott, Boston, Mass.	U. S.
Dr. A. G. Young, Augusta, Me.	
Dr. Cressy L. Wilbur, *Secretary*, Lansing, Mich.	

The Commissioners for the United States request the coöperation of all societies and individuals interested in obtaining uniform and thoroughly comparable mortality statistics, and especially desire suggestions as to needed changes in the classification. It is urged that all who may be willing to assist in the work to notify the Commission at as earlier a date as possible, so that their names can be registered and all necessary information can be sent to them. Medical journals are requested to bring this announcement to the attention of the profession, and secretaries of societies are likewise asked to present the same to their organizations.

A pamphlet containing the official version of the classification, and showing the inclusion of terms, will be ready for distribution about January 1, 1899, and will be sent to all who may signify their desire to aid in the work of revision. A few copies of the classification as

adopted in Michigan, showing the general arrangement of the system but not the details of inclusion, are still on hand, and will be sent as long as they last to those who desire them. They will serve to convey a general idea of the plan of classification. Correspondence is solicited with all interested in the preparation of a thoroughly satisfactory classification of causes of death, and the amendments and suggestions of registrars and statisticians in other countries, even those continuing to use different systems of classification, are desired. If correspondents will kindly suggest names of persons or societies who would probably take part in this work, the favor will be appreciated. Marked copies of any publications referring to the work of revision are requested.

It is requested that all communications be sent to Cressy L. Wilbur, M.D., Secretary U. S. Commission, Lansing, Michigan.

BIRTH RATE IN ENGLAND.

Is the Birth-rate Still Falling? By R. H. Hooker, M.A. In *Manchester Statistical Society Transactions.* Session 1897–98. Pp. 101–126.

Eminent authorities have maintained within the last ten years that the birth rate in Europe and in the United States is rapidly declining. This view, however, has recently been questioned. Mr. Hooker contends that it is not tenable so far as the birth rate of England is concerned. He endeavors to show, first, that the marriage rate, after remaining at a stationary average level until the early seventies, fell abruptly between the years 1873 and 1879, and that it has since remained stationary; and, secondly, that the present steadiness in the marriage rate points to a cessation in the decline of the birth rate. By birth rate and marriage rate Mr. Hooker means throughout the number of births and marriages per 1000 of the total population.

A comparison of the expert curve and marriage rate shows that until 1876 the two rose and fell together, but that from 1877–79 the rate fell abruptly, while the expert curve, after falling sharply from 1873–76, "shows a decidedly slackened downward movement, the natural consequence of which should be a slackening of the fall in the

marriage rate during the years 1877–79, if we assume a close connection between the two." After 1879 the marriage rate again rises and falls, though at a lower level, with fluctuations in trade prosperity, and manifests no further tendency to decline. A curve for the marriage rate corrected on the hypothesis of a fall of 1.7 per 1000 in the three years 1877–79 agrees much more closely with the expert curve than does the one constructed by Dr. Ogle on the hypothesis of a continuous fall, and continues to agree with it, which Dr. Ogle's, if extended to the present time, does not. The change in the marriage rate should therefore be attributed, not to a continuous decline, but to a sudden drop during the years 1877–79.

The decrease in the marriage rate may be accounted for by an increase in the number of persons who defer marriage. But in order that the marriage rate may be maintained at a lower level, the tendency to defer marriage must increase in arithmetical progression. For, "if a certain number are only *deferred* for a period, these marriages will come off in the next succeeding period, and if only a similar number are again deferred these last will cancel the former, and the rate will go up to its former level again." Such an increasing tendency to defer marriage will naturally result in a steady rise in the average age of persons marrying, and similarly a steadily decreasing marriage age will also be accompanied by a constant though much lower marriage rate.

Assuming that the returns of minors marrying indicate the variations in the strength of the tendency to defer marriage, we may conclude that the age at which marriage was on the average contracted in England and Wales steadily declined up to 1874, and that it has been steadily rising ever since,— the conditions necessary for a sudden fall after 1874 from a higher to a lower stationary marriage rate.

The rapid fall in the marriage rate was followed by a fall in the birth rate, which continued until 1890,— a period of fourteen years. Since 1890 the birth rate has been very unsteady, but apparently manifesting a tendency to decline. It is not improbable, however, that the depressing effects of the fall in the marriage rate ceased about 1890. In 1887 the ratio of births to marriages was the same as in 1876,— the year in which the drop in the marriage rate set in. But the average ratio for the period 1887–95 was below the average

for 1857–76. The difference may be attributed almost entirely to the continued fall (slightly interrupted during periods of business depression) in the illegitimate birth rate, since the ratio of legitimate births to marriages — the true test of a declining rate — was practically the same in both periods. The decline in this ratio since 1889 is not due to a decrease in the legitimate birth rate, but is rather indicative of an upward movement in the marriage rate. The ratio may diminish for a number of years even if the marriage and birth rate should rise.

These considerations point to the conclusion that, while illegitimacy may continue to decline, no material fall in the birth rate in the near future need be apprehended. Indeed, it is not unlikely that the marriage and birth rates are even now on the point of rising.

H. J. GERLING.

BIRTH RATE IN FRANCE.

L'affaiblissement de la natalité est-il un bien ou un mal? By Charles Morene. In *La Réforme Sociale.* July, 1898.

The object of this article is to show that from an economic standpoint the low birth rate in France is an evil, and also that the evil is not remedied by immigration.

An increase in the means of subsistence may cause an increase in the birth rate. But other causes, religious, moral, and physiological, may also cause an increase in the rate. In an increasing population there will be a growing demand for labor, which, combined with the effort to maintain if not to improve the standard of living, will lead to a quest for new employments and wider markets. The intelligent and well-to-do attracted by the increased opportunities will direct their attention to business pursuits instead of seeking to enter the service of the State, as they now do in France.

In this manner an increase in the population of intelligent and energetic races that have accumulated capital will stimulate enterprise and thus contribute to the country's prosperity. Thus the wealth of England and of Germany has steadily risen, while France, whose population is stationary, is in danger of losing her old preponderance.

The low birth rate in France being, therefore, a symptom of decay is a great and threatening evil.

Is a sufficient economic advantage gained by immigration to overcome this evil? It seems not. The presence of foreigners does not materially increase the proportion of persons of productive age, as the percentage of children among them is quite as large as among the native French population. Further, a large proportion of the immigrants who come to France do not intend to remain, and many of those who do remain are not assimilated. An increase in the population due to immigration is, therefore, largely fictitious. The foreigners, moreover, are for the most part poor, and many of them, especially the Italians, are wretched and degraded, frequently forming a disturbing element in the community. Such a population can not add to the wealth and commercial prosperity of France. Immigration, therefore, does not contribute sufficiently to the economic advantages of France to compensate for the evil of the low birth rates.

H. J. GERLING.